January 1996, Vol. 29, No. 11

Focus. . . Neural Tube Defects

Neural tube defects are some of the more common and devastating birth defects. The term neural tube defect (NTD) includes anencephaly (absence of the brain) and spina bifida (failure of the spinal column to properly enclose the spinal cord). Anencephaly is a fatal condition; spina bifida also is associated with high rates of fetal and infant death and with lifelong physical disability.

Since the early 1980s there have been two factors that may have an impact on the observed incidence of NTDs: advances in prenatal diagnosis of NTDs through the use of high-resolution ultrasound and widespread availability of maternal serum alpha-fetoprotein (MSAFP) screening, a prenatal blood test, allowing women the option of terminating NTD-affected pregnancies;1 and the identification of folic acid, one of the B vitamins, as a protector against NTDs, with the potential for prevention of many NTDs.2 Lentils and beans, green leafy vegetables, orange juice, fortified breakfast cereals and multi-vitamins are some sources of folic acid. Because neural tube development occurs very early in pregnancy and many pregnancies are unplanned, the Centers for Disease Control and Prevention (CDC) recommends that all women capable of child-bearing regularly consume 0.4 mg of folic acid daily (the amount in most multi-vitamins). The CDC estimates that increased folic acid intake could reduce the incidence of NTDs by 50 percent. Its recommendations were published in September 1992.2

For this report we studied NTDs reported on live-birth certificates, newborn hospital patient abstracts and infant death certificates for 1989-94 live births, all linked to form a registry of NTDs. Data on fetal deaths (of 20 or more weeks' gestation) were obtained from the fetal death certificate. No birth defect data are available for induced terminations of pregnancies, nor for early spontaneous abortions.

Table 1 lists by year the number of live births and fetal deaths with NTDs, with rates per 10,000 live births and fetal deaths. For 1989-94, 348 (7.5 per 10,000) live births and fetal deaths had NTDs, of which 111 were anencephaly and 237 were spina bifida. (Of these, 284 were live births and 64 were fetal deaths; the combined fetal/infant death rate for NTDs was 48.6 percent.) No general decrease in the incidence rate of NTDs between 1989 and 1994 is apparent, nor were decreases observed for maternal race, age, or residence (urban or rural) subcategories.

In Table 2 are displayed the number and rates of NTDs per 10,000 live births and fetal deaths by selected characteristics. Births to white women have a statistically significantly higher rate of NTDs than births to black women (7.9 and 5.9 per 10,000, respectively).

Examination of NTD rates by age for all races indicates that the risk of NTD falls with increased maternal age, but that the differences are not statistically significant. We also examined white and black rates by maternal age. White mothers had NTD rates of 11.3, 8.2, and 4.8 per 10,000 for ages less than 20, 20-29, and 30+ years, respectively; the rate for NTDs to white mothers 30 or older is significantly lower than the rates for women less than 20 and for those aged 20-29. NTD births to black women increased with higher maternal age (3.3, 5.7, and 9.7 for births to women ages less than 20, 20-29, and 30+, respectively), but the numbers of NTD births are small, and the NTD rate for black women aged 30 and older is significantly high only in comparison with that for black women less than 20.

Female births had higher NTD rates than male births (8.1 and 6.7, respectively), but the difference is not statistically significant. The 9.6 NTD rate for residents of rural areas is significantly higher than that for urban residents, and the difference is not an artifact of the differing racial makeup of the two groups, because both black and white NTD rates are higher for rural residents.

Maternal education of 13 or more years is associated with a 5.6 rate of NTDs, significantly lower than for births to mothers with high school and less than high school education. Third- and higher-order births have a significantly higher NTD rate than first or second births. There are fewer high-order births among college-educated women, but NTD rates among college-educated women are also high for third- and higher-order births in comparison with first and second births.

Women who do not obtain first trimester prenatal care have a significantly higher rate of NTDs (9.3) than those who do (6.9). Women reporting Medicaid participation during pregnancy also had a significantly higher NTD rate than non-Medicaid participants (8.6 and 6.7, respectively). Higher rates were also observed for WIC (Special Supplemental Food Program for Women, Infants, and Children) and Food Stamp recipients, but these differences were not statistically significant.

The differences in NTD rates among these various sub-populations of Missouri births may reflect true differences in the incidence of NTDs, including variations due to differences in folic acid intake, or differing access to and/or utilization of prenatal diagnostic procedures and pregnancy terminations. (It is also possible that there are variations in the completeness of NTD reporting, but NTDs are in most cases easily recognized and NTD reporting is believed to be nearly complete.)

Higher NTD rates for whites and for births to younger women observed among Missouri births have been observed elsewhere.3 Also documented are higher rates of NTDs among births to women of low socio-economic status (SES).4 Variables such as maternal age, education, rural/urban residence, birth order, early prenatal care, and Medicaid participation are to greater or lesser extent measures of SES. Lower SES mothers, mothers of low education, and young mothers may have poorer diets, contributing to higher NTD rates, but they may also be less likely to have NTDs diagnosed prenatally or to have induced terminations of NTD-affected pregnancies.

The high cost of NTDs is displayed in Table 3. From the 1993 and 1994 hospital patient abstract data sets, the charges for newborn and infant Missouri resident discharges with NTDs noted were obtained and contrasted to discharges for all other newborn and infant discharges. This latter group includes normal, healthy infants and infants with other birth defects or other health conditions, such as those related to prematurity. Because anencephaly is a fatal condition, and liveborn anencephalic infants generally die within a few hours of birth, the costs associated with their care are very low (mean=$728). Spina bifida, however, generally requires extensive medical and surgical care. There were 55 liveborn newborn discharges and 119 transfer and re-admission discharges noting spina bifida; the charges associated with these discharges averaged $60,724 per newborn, in contrast to average charges of $4,812 for all other infants. These charges represent only charges for inpatient hospital care in the first year of life; physician fees, outpatient care, and hospital care after the first birthday, as well as non-medical expenses, are not included.

Thus we see that although the number of NTD-affected births in Missouri is quite small, averaging 58 per year for 1989-94, NTDs are severe defects that carry high economic and non-economic costs. The possibility of a 50 percent reduction in NTD rates by increased folic acid intake is a significant public health breakthrough. The rate of NTDs among Missouri births has not yet shown a decrease since the September 1992 CDC recommendations. Increased efforts by public and private health care providers, nutritionists, and health educators to emphasize the importance of adequate folic acid intake by women of childbearing age could lead to significant decreases in the incidence of these serious birth defects by the year 2000.

References:

1Centers for Disease Control. *MMWR*. 1995; 44: SS-4.

2Centers for Disease Control. *MMWR*. 1992; 41: RR-14.

3California Birth Defects Monitoring Program. *Birth Defects in California: 1983-1990*. California: 1994.

4Elwood JM, Elwood JH. *Epidemiology of Anencephalus and Spina Bifida*. New York: Oxford University Press; 1980.

Table 1

Neural Tube Defects (NTDs) with Rates per 10,000 by Year of Birth:
Missouri Resident Live Births and Fetal Deaths 1989-94

	Number			*Rate per 10,000*		
				Live Births and Fetal Deaths		
Year of Birth	*All NTDs*	*Anencephaly*	*Spina Bifida*	*All NTDs*	*Anencephaly*	*Spina Bifida*
1989	61	20	41	7.7	2.5	5.2
1990	53	12	41	6.6	1.5	5.1
1991	62	26	36	7.8	3.3	4.5
1992	59	20	39	7.7	2.6	5.1
1993	54	16	38	7.1	2.1	5.0
1994	59	17	42	8.0	2.3	5.7
Total	348	111	237	7.5	2.4	5.1

Number of Live Births and Fetal Deaths 465,082

Table 2

Neural Tube Defects with Rates per 10,000 by Selected Characteristics:

Missouri Live Births and Fetal Deaths 1989-94

	Number	*Rate*		*Number*	*Rate*
Maternal Race			Prenatal Care		
White	300	7.9*	Early	254	6.9
Black	47	5.9	Late/None	85	9.3*
Maternal Age			Maternal Education		
<20	58	8.7	<12	83	8.7
20-29	206	7.7	12	154	8.6
30+	81	6.2	13+	104	5.6 **
Residence			Program Participation during Pregnancy:		
Rural	106	9.6*	Medicaid		
Urban	242	6.8	Yes	137	8.6*
			No	195	6.7
Sex					
Female	184	8.1	WIC		
Male	159	6.7	Yes	127	7.8

			No	203	7.1
Birth Order					
1st-2nd	227	6.7	Food Stamps		
3rd +	121	7.9*	Yes	77	7.7
			No	253	7.2

*Rate is statistically significantly higher than corresponding rate ($p < .05$).

**Rate for 13+ years education is significantly lower than rates for < 12 and 12 years.

Table 3

Hospital Discharges and Average Charges for Infants with Selected Conditions

Reported in the Patient Abstract Data Set: Missouri 1993-94

	Number of Discharges		
	Newborn	*Transfers/ Readmissions***	*Average Charge**
			Per Infant
Liveborn infants with NTDs	67	119	$49,978
Anencephaly	12	0	728
Spina Bifida	55	119	60,724
All Other Infants	138,880	27,638	$4,812

*Total charges recorded on abstracts with reported conditions, divided by number of newborn abstracts with condition noted.

**Within one year of birth.

Provisional Vital Statistics for November 1995

Live Births increased in November as 6,816 Missouri babies were born compared with 6,211 in November 1994. The November birth rate was 15.7 per 1,000 population compared with 14.3 one year earlier.

Cumulative births, however, continue to show slight decreases in 1995. For January-November, the birth rate decreased from 14.3 to 14.1 per 1,000 population.

Deaths increased in November as 4,979 Missourians died compared with 4,587 in November 1994. Cumulative deaths for the 11- and 12-month periods ending with November also show slight increases.

The **Natural Increase** for Missouri in November was 1,837 (6,816 births minus 4,979 deaths). This represents a slight increase from the 1,624 persons added one year earlier.

Marriages increased slightly for all three time periods shown below, while **Dissolutions of Marriage** increased in November but decreased for the cumulative 11- and 12-month periods ending with November.

Infant Deaths decreased for all three time periods shown below.

Item	November				Jan.-Nov. cumulative				12 months ending with November				
	Number		Rate*		Number		Rate*		Number			Rate*	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1993	1994	1995
Live Births	6,211	6,816	14.3	15.7	69,283	68,923	14.3	14.1	75,131	74,404	14.6	14.2	14.0
Deaths	4,587	4,979	10.6	11.4	49,331	49,860	10.2	10.2	53,857	54,121	10.3	10.2	10.2
Natural increase	1,624	1,837	3.7	4.2	19,952	19,063	4.1	3.9	21,274	20,283	4.4	4.0	3.8
Marriages	3,082	3,702	7.1	8.5	41,832	42,044	8.6	8.6	45,056	45,282	8.5	8.5	8.5
Dissolutions	2,226	2,251	5.1	5.2	24,307	24,215	5.0	5.0	26,539	26,349	5.0	5.0	5.0
Infant deaths	59	58	9.5	8.5	546	515	7.9	7.5	604	568	8.4	8.0	7.6
Population base (in thousands)	...	...	5,278	5,323	...	...	5,278	5,323	...	...	5,230	5,274	5,319

*Rates for live births, deaths, natural increase, marriages and dissolutions are computed on the number per 1000 estimated population. The infant death rate is based on the number of infant deaths per 1000 live births. Rates are adjusted to account for varying lengths of monthly reporting periods.

Alternate forms of this publication for persons with disabilities may be obtained by contacting the Missouri Department of Health, Center for Health Information Management & Epidemiology/Bureau of Health Data Analysis, P.O. Box 570, Jefferson City, MO 65102; phone (573) 751-6278. Hearing impaired citizens telephone 1-800-735-2966.